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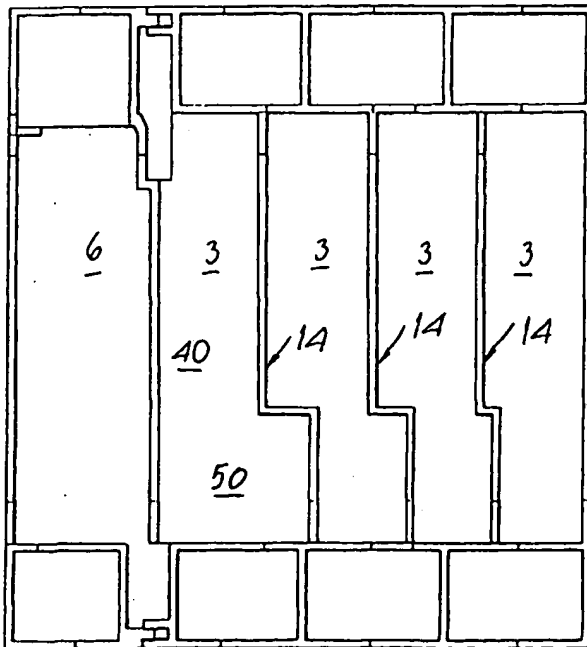
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(54) Title: MODULAR FOUR-POLE RESIDUAL CURRENT CIRCUIT BREAKER



(57) Abstract: A modular four-pole residual current circuit breaker, comprising: --an enclosure, on which there are terminals for input and output connection to corresponding conductors of an electric circuit, with a front wall from which an actuation lever protrudes, a rear wall, two side walls that are substantially parallel to each other and whose distance is four times a base module M, a lower wall and an upper wall, the enclosure containing: --first, second, third and fourth magnetothermal interruption units, which are arranged mutually side by side and are separated by dividing walls, an input terminal and an output terminal being associated with the units; --a residual current protection unit, arranged at one of the lateral ends of the enclosure and laterally adjacent to the first magnetothermal interruption unit; its particularity consists of the fact that in a front view, the dividing wall between the first and second magnetothermal units is substantially step-shaped and forms a compartment for accommodating the first magnetothermal unit that has an upper part and a lower part that have mutually different widths, the lower part of the compartment being wider than the upper part and accommodating a transmission lever that is suitable to functionally couple the kinematic mechanism of the residual current unit with the kinematic mechanism of the magnetothermal units

that are laterally adjacent to it.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## MODULAR FOUR-POLE RESIDUAL CURRENT CIRCUIT BREAKER

DESCRIPTION

The present invention relates to a modular four-pole residual current circuit breaker; more particularly, the present invention relates to a modular residual  
5 current circuit breaker that comprises, on one side, four magnetothermal interruption compartments and, laterally thereto, so as to form a single block, a residual current protection compartment.

It is known that the enclosure of a device that is termed modular has two mutually parallel side walls that are mutually spaced by a preset base multiple  
10 that is common to all modular devices of the same kind, as set by appropriate standards.

These modular devices are engaged on supporting guides by virtue of an appropriate shaped region provided on the wall for fixing said enclosure and are arranged mutually side by side so as to optimize space occupation.

15 In a modular multipole residual current circuit breaker, the magnetothermal interruption compartments are usually arranged parallel to each other and all have the same width, which is equal to one base module.

According to a first solution that is known in the art, the residual current protection chamber is usually arranged parallel to the magnetothermal  
20 interruption compartments and is laterally adjacent, on one side or the other, with respect to the magnetothermal interruption assembly that has formed, and its width is generally equal to three times the base module.

The main drawback of this solution is the fact that the total width of the resulting four-pole residual current circuit breaker is usually equal to seven  
25 times the base module; accordingly, the space required during application is considerable.

A second solution that is known in the art provides an embodiment in which the total width of a four-pole residual current circuit breaker is brought to four

times the base module, with the consequent benefit, by virtue of its smaller dimensions, of a more efficient utilization of the space available for assembly.

This solution is achieved because the width of each one of the magnetothermal interruption compartments is equal to the base module and the residual current  
5 protection chamber is arranged longitudinally above or below the magnetothermal interruption compartments, as if the volume available inside the enclosure were divided in two along a plane that is perpendicular to the side walls of the enclosure and to its fixing wall, so that part of this volume is divided transversely between the various magnetothermal interruption  
10 compartments while the other part is occupied longitudinally by the residual current protection element.

Even this embodiment, however, has drawbacks; in particular, the axis of the magnetic protection device of each one of the magnetothermal interruption compartments lies in practice transversely to the fixing wall of the enclosure, to  
15 the detriment of the volume available for the arc quenching chamber that is normally associated with the interruption contacts, consequently reducing the breaking capacity.

Furthermore, in this solution the residual current protection compartment lies longitudinally along the entire width of the enclosure and transversely to the  
20 magnetothermal interruption compartments, so as to make the electrical connections among the many internal components of these compartments particularly complicated and disadvantageous to provide.

According to a third solution that is known in the art, the residual current protection compartment is assembled with the magnetothermal interruption  
25 compartments by arranging it in a central position; in practice, two magnetothermal circuit breakers are assembled sequentially, followed by the residual current unit and then by the second pair of magnetothermal circuit breakers.

This particular embodiment does not allow to assemble all the magnetothermal circuit breakers in the absence of the residual current protection compartment, thus preventing the possibility to perform tests on the entire magnetothermal part without the residual current protection compartment.

- 5 Accordingly, in case of poor operation of the magnetothermal parts, the assembled residual current part is also unusable, consequently wasting material and increasing production times and costs.

Furthermore, the need to preassemble the circuit breaker completely forces the production and stocking of circuit breakers of various sizes and with various  
10 performances, regardless of the actual demands and needs of the market and with the consequent risk of holding in stock devices that might not be required.

The aim of the present invention is to obviate the drawbacks cited above, and in particular to provide a modular four-pole residual current circuit breaker that is highly compact and has an optimized performance.

- 15 Within the scope of this aim, an object of the present invention is to provide a modular four-pole residual current circuit breaker that is simple to manufacture and most of all facilitates the steps for the assembly of the various internal components.

Another object of the present invention is to provide a modular four-pole  
20 residual current circuit breaker that facilitates testing and at the same time allows to organize and optimize inventory reserve management.

Another object of the present invention is to provide a modular four-pole residual current circuit breaker that is highly reliable, relatively easy to provide, and at competitive costs.

- 25 This is achieved by means of a modular four-pole residual current circuit breaker, comprising:

-- an enclosure, on which there are terminals for input and output connection to corresponding conductors of an electric circuit, said enclosure having a front

wall from which an actuation lever protrudes, a rear wall, two side walls that are substantially parallel to each other and whose distance is four times a base module M, a lower wall and an upper wall, said enclosure containing:

- 5 -- first, second, third and fourth magnetothermal interruption units, which are arranged mutually side by side and are separated by dividing walls, an input terminal and an output terminal being associated with said units;
- a residual current protection unit, arranged at one of the lateral ends of said enclosure and laterally adjacent to said first magnetothermal interruption unit; characterized in that, with respect to a front view, the dividing wall between
- 10 said first and second magnetothermal units is substantially step-shaped and forms a compartment for accommodating the first magnetothermal unit that has an upper part and a lower part that have mutually different widths, the lower part of said compartment being wider than the upper part and accommodating a transmission lever that is suitable to functionally couple the kinematic
- 15 mechanism of the residual current unit with the kinematic mechanism of the magnetothermal units that are laterally adjacent to it.

In this manner, the space available inside the enclosure is conveniently distributed between the magnetothermal interruption units and the residual current interruption unit, obtaining, by means of an appropriate configuration of

20 the dividing walls, the space required to receive the lever for coupling between the magnetothermal part and the differential part; accordingly, the assembly is highly compact, allowing to obtain a four-pole residual current circuit breaker with a total width equal to four times the base module.

Another considerable advantage of the circuit breaker according to the

25 invention is the fact that by virtue of the arrangement of the residual current protection compartment at one of the ends of the enclosure, it is possible to divide the operation for assembling the circuit breaker into two separate steps, the first one being related to the assembly of the magnetothermal

compartments, the second one being related to the assembly of the residual current protection compartment, to be performed after a test on the magnetothermal section, which is already ready, and only depending on the specific requirements and/or needs of application.

- 5 This allows to avoid assembling the entire circuit breaker if the magnetothermal section does not pass the test; moreover, this approach allows to optimize inventory reserves, since it is possible to preassemble and stock only the magnetothermal section, assembling the remaining residual current part when required and according to the required protection power. This reduces the costs  
10 of inventory reserves and production costs if the various tests are not passed. Moreover, the arrangement according to the invention allows advantageously to assemble some components in the manner that is already known in the art, with a consequent economic benefit.

- Further characteristics and advantages of the invention will become apparent  
15 from the description of preferred but not exclusive embodiments of the circuit breaker according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a perspective view of a four-pole residual current circuit breaker according to the invention;

- 20 Figure 2 is a schematic view of the internal arrangement of the compartments of the circuit breaker of Figure 1;

Figure 3 is a perspective view of the set of the internal components of said four-pole residual current circuit breaker;

Figure 4 is a front view of the set of assembled magnetothermal compartments;

- 25 Figure 5 is a schematic side view of a magnetothermal interruption unit used in the four-pole residual current circuit breaker according to the invention;

Figure 6 is a schematic side view of the residual current protection unit used in the circuit breaker according to the invention;

Figure 7 is a detail perspective view of a transmission lever during coupling with the kinematic mechanism of the residual current unit and with the kinematic mechanism of the magnetothermal unit that is laterally adjacent thereto.

5 With reference to the above cited figures, the four-pole residual current circuit breaker 1 according to the invention comprises four magnetothermal interruption units 3, which are mutually assembled in a same enclosure 2 that has a width L equal to four times a base module M, said units being all mutually laterally adjacent, an input terminal 4 and an output terminal 5 being  
10 associated with each one of said units, and a residual current protection unit 6.

In particular, said base module, taking into account normal manufacturing tolerances, is generally equal to  $17.5\text{ }(^{+0.5}_0)$  mm, as set by the DIN 43880 standard.

As shown in Figure 1, the enclosure 2 comprises: two parallel side walls 7,  
15 whose distance determines a width equal to L; a rear fixing wall 8, which is shaped appropriately so as to facilitate engagement on a suitable supporting guide, not shown in the figures, in manners that are widely known in the art; an upper wall 10 and a lower wall 11, which are perpendicular to the fixing wall 8 and to the side walls 7 and on which the input and output terminals protrude  
20 respectively for the connection of conductors of a circuit with the magnetothermal interruption units 3. Finally, the enclosure 2 has a front wall 13 that lies substantially parallel to the fixing wall 8 and from which a rotating actuation lever 19 protrudes outside said enclosure 2 and is available to users; furthermore, in the illustrated embodiment, said wall 13 allows access to the  
25 clamps for tightening or loosening the corresponding input terminal 4 and output terminal 5; as an alternative, both the terminals and the corresponding clamps might be arranged differently according to the requirements.

As shown in Figures 2 and 4, the magnetothermal interruption units 3 are



arranged in the enclosure 2 so that they are mutually side by side and separated by partitions or walls 14, which help to form respective containment compartments; furthermore, the residual current protection unit 6 is in turn arranged at one of the lateral ends of said enclosure and is laterally adjacent to  
5 one of the magnetothermal interruption compartments 3.

Advantageously, in the embodiment of the circuit breaker according to the invention, in a front view, at least the dividing wall 14 that is interposed between the magnetothermal unit that is laterally adjacent to the residual current unit 6 and the magnetothermal unit that directly follows it is substantially step-  
10 shaped and forms a containment compartment that has an upper part 40 and a lower part 50 that have mutually different widths, the lower part 50 being wider than the upper part 40 and accommodating a transmission lever; said lever, designated by the reference numeral 28 in Figure 7, is suitable to functionally couple the kinematic mechanism of the residual current unit 6, generally  
15 designated by the reference numeral 60, with the kinematic mechanism of the magnetothermal unit 3 that is laterally adjacent thereto, designated by the reference numeral 30.

In particular, as shown in Figure 7, the transmission lever 28 has a contoured body with means for functional coupling, at one end, to a first lever 61 of the  
20 kinematic mechanism 60, for example a relay reset lever, and at the other end to a second trip lever 31 that belongs to the kinematic mechanism 30 of the unit 3 that is laterally adjacent to the residual current unit 6; furthermore, said levers 28, 61 and 31 are mutually coupled so as to be mutually aligned along an axis B1 that lies along the line that connects the two side walls 7.

Preferably, and as shown in Figure 2 and 4, all the dividing walls 14 that  
25 mutually separate in pairs the magnetothermal interruption units 3, have a substantially step-like shape in a front view and form containment compartments for the units 3 which have an upper part 40 and a lower part 50

that have preferably mutually different widths; furthermore, the lower part 50 of the first compartment 3, i.e., the compartment that is adjacent to the residual current protection unit 6, is wider than the lower part of the remaining magnetothermal interruption compartments 3.

- 5 According to the illustrated embodiment, the input terminals 4, which are all mutually aligned on one side and, at said input terminals, the output terminals 5, which are likewise all mutually aligned, on the other side, are distributed with a regular spacing that is equal to the base module M from one of the side walls 7 to the other, so that at right angles to said side walls 7 they are all staggered  
10 with respect to the magnetothermal interruption compartments 3 with which they are respectively associated.

In practice, the input or output terminals 4 or 5 that are at the end of the corresponding alignments are at a distance from the side walls 7 of the enclosure 2 that is equal to half the base module M.

- 15 All the magnetothermal interruption units 3 have substantially the same structure.

As shown in Figures 3 to 5, said units comprise; inserted between the respective input and output terminals 4 and 5, an electromagnetic device 15 for protection against overcurrents/short circuits, at least one fixed contact 16 and a moving  
20 contact 17, with which at least one arc quenching chamber 23 is associated, and a thermal protection device 18, for example a bimetal, for protection against overloads; furthermore, each magnetothermal protection unit 3 comprises an opening/closure kinematic mechanism 30, the kinematic mechanisms 30 of the various units 3 being mutually functionally connected according to  
25 embodiments that are known in the art and are accordingly not described in detail.

Said kinematic mechanisms 30, which comprise in particular the already mentioned release lever 31, and a contact-carrying lever 32 on which the

respective moving contact 17 is arranged, according to embodiments that are widely known in the art and are therefore not described in detail, are suitable, under the action of the protection devices 15 or 18, to make the moving contacts 17 pass from a closed position, in which they are coupled to the  
5 corresponding fixed contacts 16, to an open position, in which they are instead separated from said fixed contacts, as shown in Figure 5. For the opposite transition, from an open position to the closed position, the kinematic mechanisms 30 are functionally controlled by the actuation lever 19.

In particular, each electromagnetic protection device 15 has a winding coil 20,  
10 which is arranged around a supporting structure 21, and a release pin 22, which is functionally controlled by the coil 20 and is suitable to act on the corresponding kinematic mechanism 30, generally on the corresponding release lever 31. In the embodiment of the circuit breaker according to the invention, and as shown in Figures 4 and 5, the axis  $A_1$  of each electromagnetic protection  
15 device 15, i.e., the axis along which the corresponding release pins 22 act, runs parallel to the side walls 7 of the enclosure 2, along the line that connects the upper and lower walls 10 and 11. Figures 4 and 5 show the axis  $A_1$  of a single pin 22 for the sake of simplicity in illustration. Furthermore, the arc quenching chamber 23 is arranged between the respective electromagnetic protection  
20 device 15 and the fixing wall 8 of the enclosure 2. By virtue of this arrangement, each electromagnetic protection device 15 can advantageously lie parallel to the fixing wall 8 of the enclosure 2, to the benefit of the space available for the arc quenching chambers 23 and therefore of the breaking capacity, which is not reduced in any way.

25 Another advantageous aspect is constituted by the fact that the winding coil 20 of the protection devices 15 can be provided by adopting standardized conductors having a rectangular cross-section or flat wires, wherein the larger dimension lies parallel to the axis  $A_1$ , Figure 5; it is thus possible to minimize

the transverse space occupation of each electromagnetic protection device 15. As an alternative, it is possible to use conductors having a circular cross-section.

In turn, the residual current protection unit 6, accommodated in the  
5 corresponding compartment formed by one of the side walls 7 and by an additional partition 14, comprises a fault detector 24, which is suitable to detect the presence of a residual current, and a per se known relay 25, which is controlled by the fault detector 24 and is provided with a movable release piston 29, as shown in Figure 6. The fault detector 24 comprises a toroidal core  
10 26 on which primary conductors 27 and a secondary winding are wound; each one of said primary conductors is electrically connected to a corresponding electromagnetic protection device 15, and the secondary winding, not shown in the figures, is functionally connected to the relay 25. In particular, as shown in Figure 3, in a front view the toroidal core 26 is advantageously arranged at the  
15 dihedral angle formed by the upper wall 10 and by one of the side walls 7 of the enclosure 2, with an axis  $A_2$  that is orientated substantially along the line that connects the front and rear walls 13 and 8; furthermore, the relay 25 is arranged under the toroidal core 26 and to the rear of the kinematic mechanism 60 of the residual current protection unit, so that the release piston 29 can move along an  
20 axis  $A_3$  that lies on a plane that is parallel to the side walls 7 of the enclosure 2, along a line that connects the front wall 13 and the rear wall 8.

In operating conditions, when the residual current is higher than a preset limit, a voltage is generated across the secondary winding, and its representative signal is supplied to the relay 25 and causes the actuation of the piston 29; in turn, the  
25 piston 29 actuates the kinematic mechanism 60 and by virtue of the coupling of the levers 61-28-31 the movement is transmitted to the mechanisms 30 so as to separate the contacts. Subsequent action on the actuation lever 19 causes, in this case also, the reclosing of the circuit breaker so that the lever 61 resets the

relay, repositioning the pivot 29.

In practice it has been found that the four-pole residual current circuit breaker according to the invention fully achieves the intended aim and objects, with significant advantages with respect to what is known in the background art.

- 5 As mentioned, the entire system is in fact assembled in an enclosure that has optimized dimensions and particularly has a width that is four times a base module M, with a consequent benefit in practical installation and with a functional performance that is not altered in any way by virtue of the particular arrangement of the various components.
- 10 Furthermore, by virtue of the arrangement of the residual current part at one end of the enclosure, the assembly of the circuit breaker can be divided advantageously into two separate steps, a first one which relates to the assembly of the magnetothermal section and a second one that relates to the assembly of the residual current section; in this manner, once the first step has ended, it is
- 15 possible to perform the necessary functional tests only on the magnetothermal part that is already ready. This allows to avoid unnecessary waste of residual current protection components in case of a malfunction that is due only to the magnetothermal section. It is also possible to stock the already-assembled magnetothermal section and complete the four-pole residual current circuit
- 20 breaker with the remaining residual current section when necessary and according to the required protection performance; this avoids inventory reserves of the already-assembled residual current circuit breaker, with a considerable reduction of operating costs.

There is also the important possibility to assemble some components in the

25 manner that is already known in the art, with a consequent economic benefit.

The circuit breaker thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with other technically equivalent elements.

In practice, the materials and the dimensions may be any according to the requirements and the state of the art.

CLAIMS

1. A modular four-pole residual current circuit breaker, comprising:

-- an enclosure, on which there are terminals for input and output connection to corresponding conductors of an electric circuit, said enclosure having a front wall from which an actuation lever protrudes, a rear wall, two side walls that are substantially parallel to each other and whose distance is four times a base module M, a lower wall and an upper wall, said enclosure containing:

-- first, second, third and fourth magnetothermal interruption units, which are arranged mutually side by side and are separated by dividing walls, an input terminal and an output terminal being associated with said units;

-- a residual current protection unit, arranged at one of the lateral ends of said enclosure and laterally adjacent to said first magnetothermal interruption unit; characterized in that, with respect to a front view, the dividing wall between said first and second magnetothermal units is substantially step-shaped and forms a compartment for accommodating the first magnetothermal unit that has an upper part and a lower part that have mutually different widths, the lower part of said compartment being wider than the upper part and accommodating a transmission lever that is suitable to functionally couple the kinematic mechanism of the residual current unit with the kinematic mechanism of the magnetothermal units that are laterally adjacent to it.

2. The residual current circuit breaker according to claim 1, characterized in that in a front view said dividing walls that mutually separate the magnetothermal interruption units are substantially step-shaped and form containment compartments for said magnetothermal interruption units which have an upper part and a lower part with mutually different widths, the lower part of the compartment that accommodates said first magnetothermal

interruption unit being wider than the lower part of the remaining compartments for accommodating the magnetothermal interruption units.

3. The residual current circuit breaker according to claim 1 or 2, characterized in that said transmission lever comprises a contoured body provided with means for functional coupling, at one end, to a first lever that belongs to the kinematic mechanism of the residual current protection unit and, at the other end, to a second lever that belongs to the kinematic mechanism of said first magnetothermal protection unit, said first lever, said transmission lever and said second lever being mutually coupled so as to be aligned along a first axis that is orientated along a line that connects the two side walls of the enclosure.
4. The residual current circuit breaker according to one or more of the preceding claims, characterized in that said input terminals, at one end, and said output terminals, at the other end, are distributed with a uniform spacing that is equal to a base module M and are staggered with respect to the containment compartments of the magnetothermal interruption units with which they are functionally associated.
5. The residual current circuit breaker according to one or more of the preceding claims, characterized in that said magnetothermal interruption units comprise an electromagnetic protection device that comprises a winding coil and a moving release pin associated therewith, said release pin being arranged along a second axis that is substantially parallel to the side walls of the enclosure, along a line that connects the upper wall and the lower wall.
6. The residual current circuit breaker according to claim 5, characterized in that said winding coil comprises conductors that have a substantially rectangular transverse cross-section.
7. The residual current circuit breaker according to one or more of the



- preceding claims, characterized in that the residual current protection unit comprises a fault detector, which is suitable to detect a residual current, and a relay, which is controlled by the fault detector and is provided with a moving release piston, said fault detector comprising a toroidal core on which
- 5 primary conductors and a secondary winding are wound, each one of said primary conductors being connected to a corresponding electromagnetic protection device, said secondary winding being functionally connected to the relay.
8. The residual current circuit breaker according to claim 7, characterized in
- 10 that said toroidal core is arranged at the dihedral angle formed by the upper wall and by one of the side walls of the enclosure, with its axis directed substantially along the line that connects the front wall and the rear wall.
9. The residual current circuit breaker according to claim 7 or 8, characterized in that in a front view said relay is arranged under said toroidal core and to
- 15 the rear of the kinematic mechanism of the residual current protection unit, so that the release piston can move along a third axis that is arranged on a plane that is parallel to the side walls of the enclosure, along a line that connects the front and rear walls.

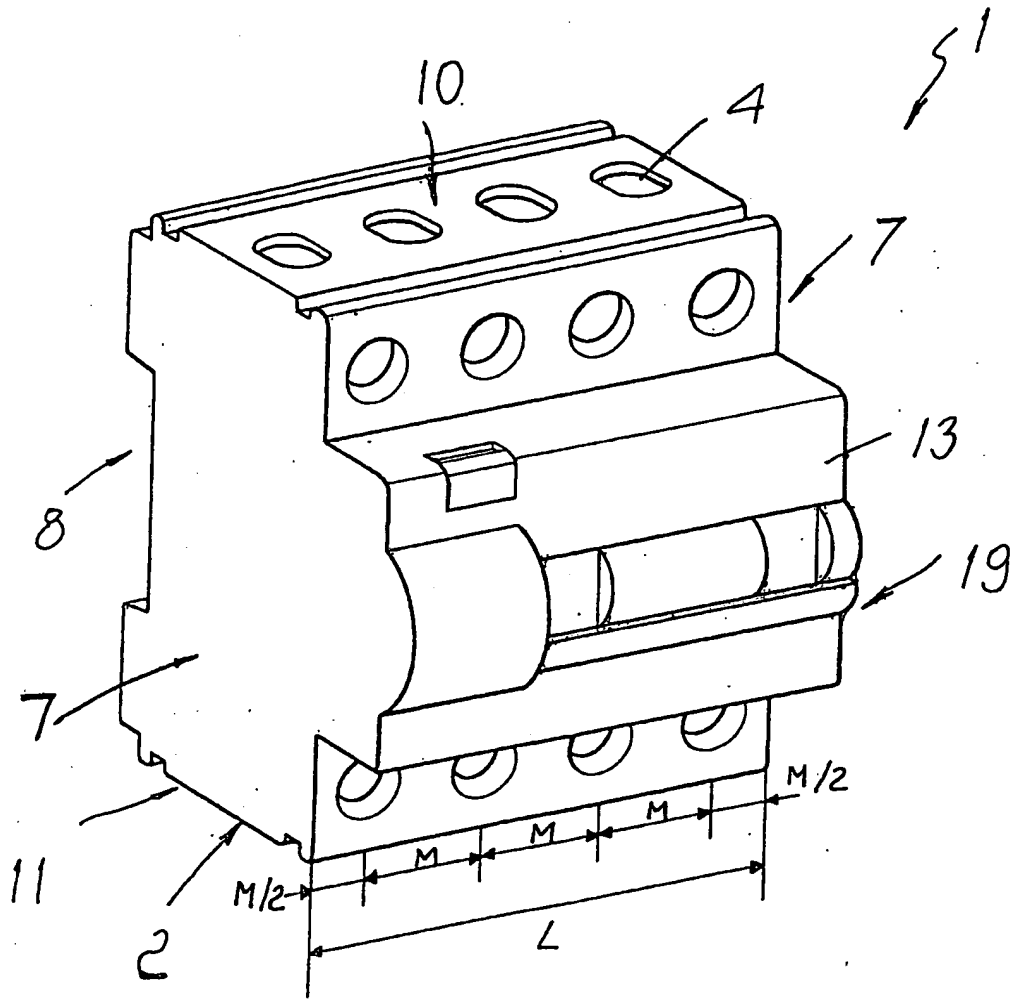


Fig. 1

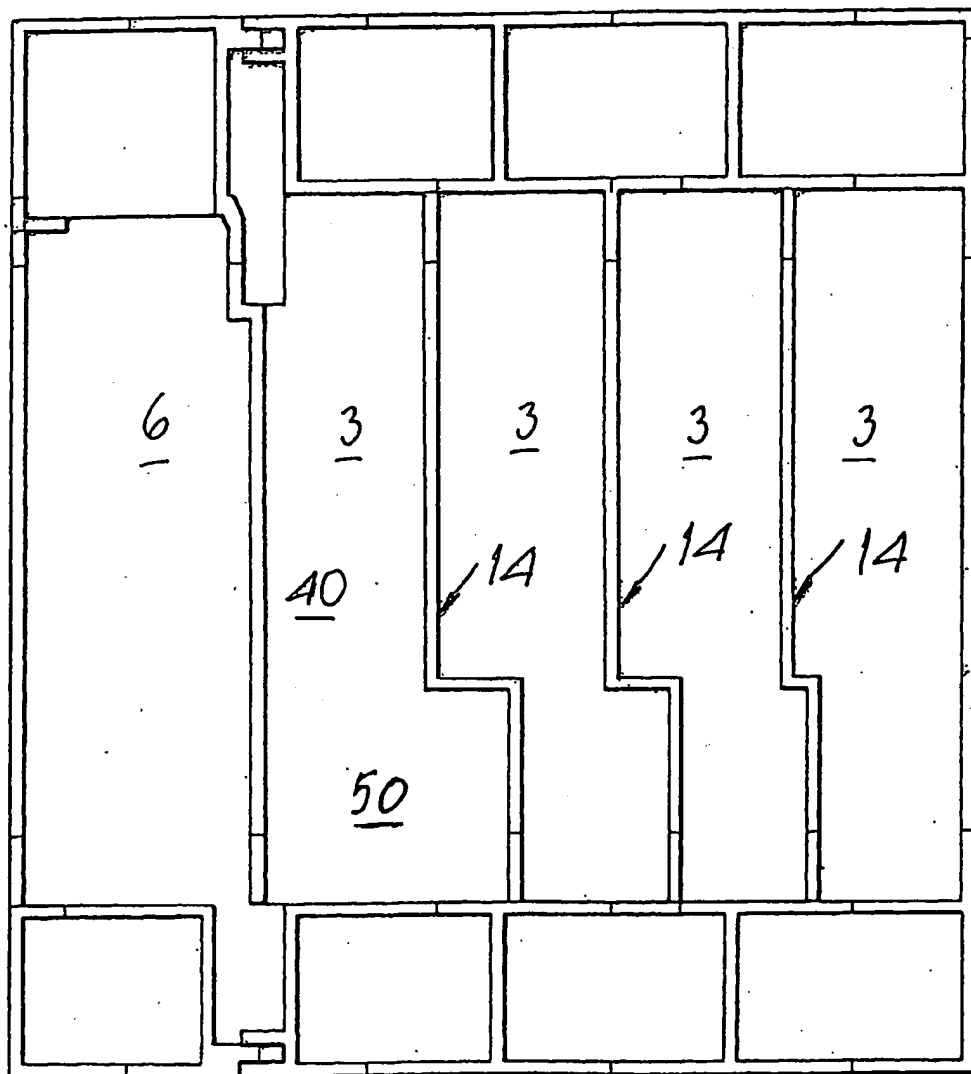


Fig. 2

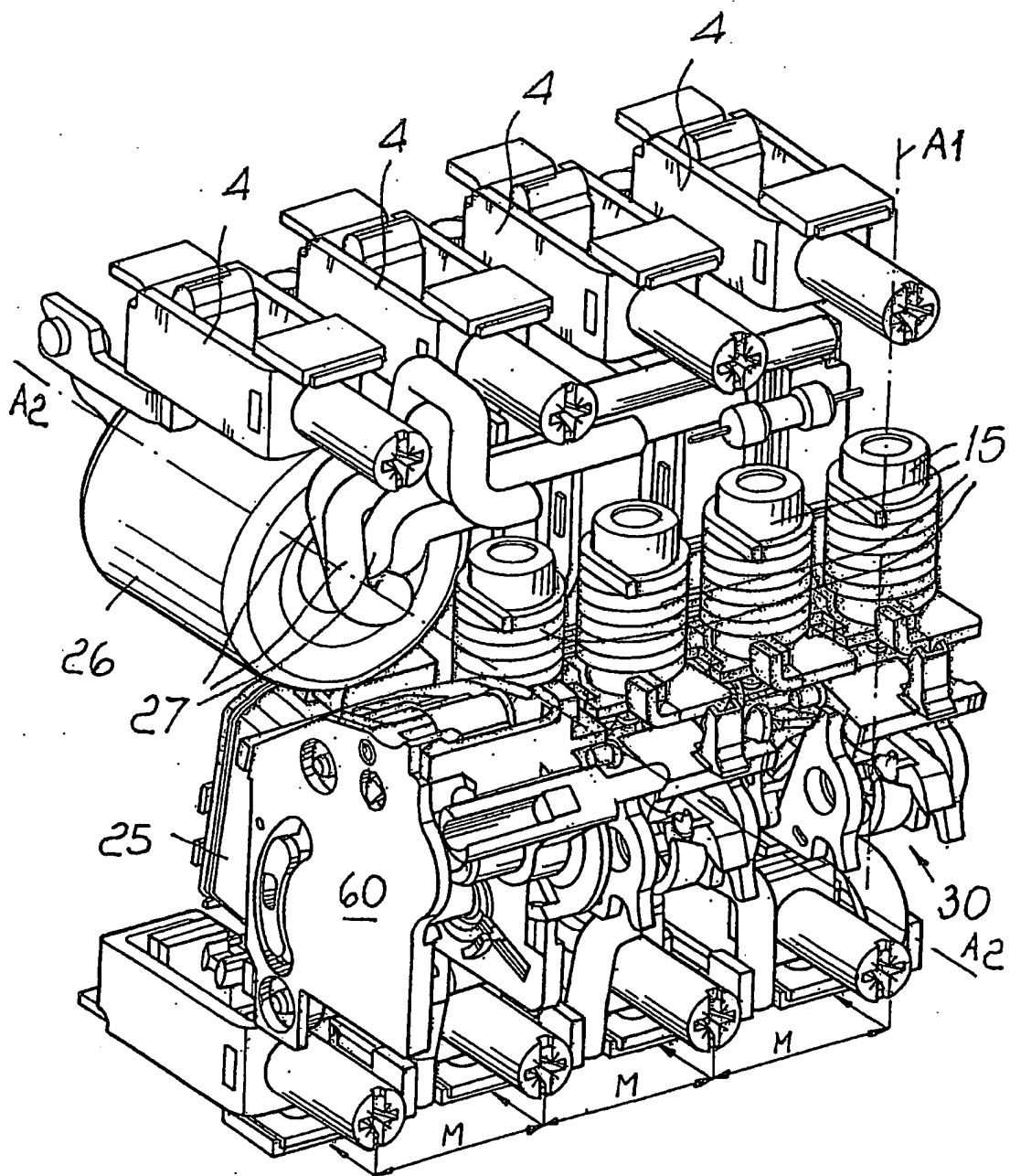


FIG. 3

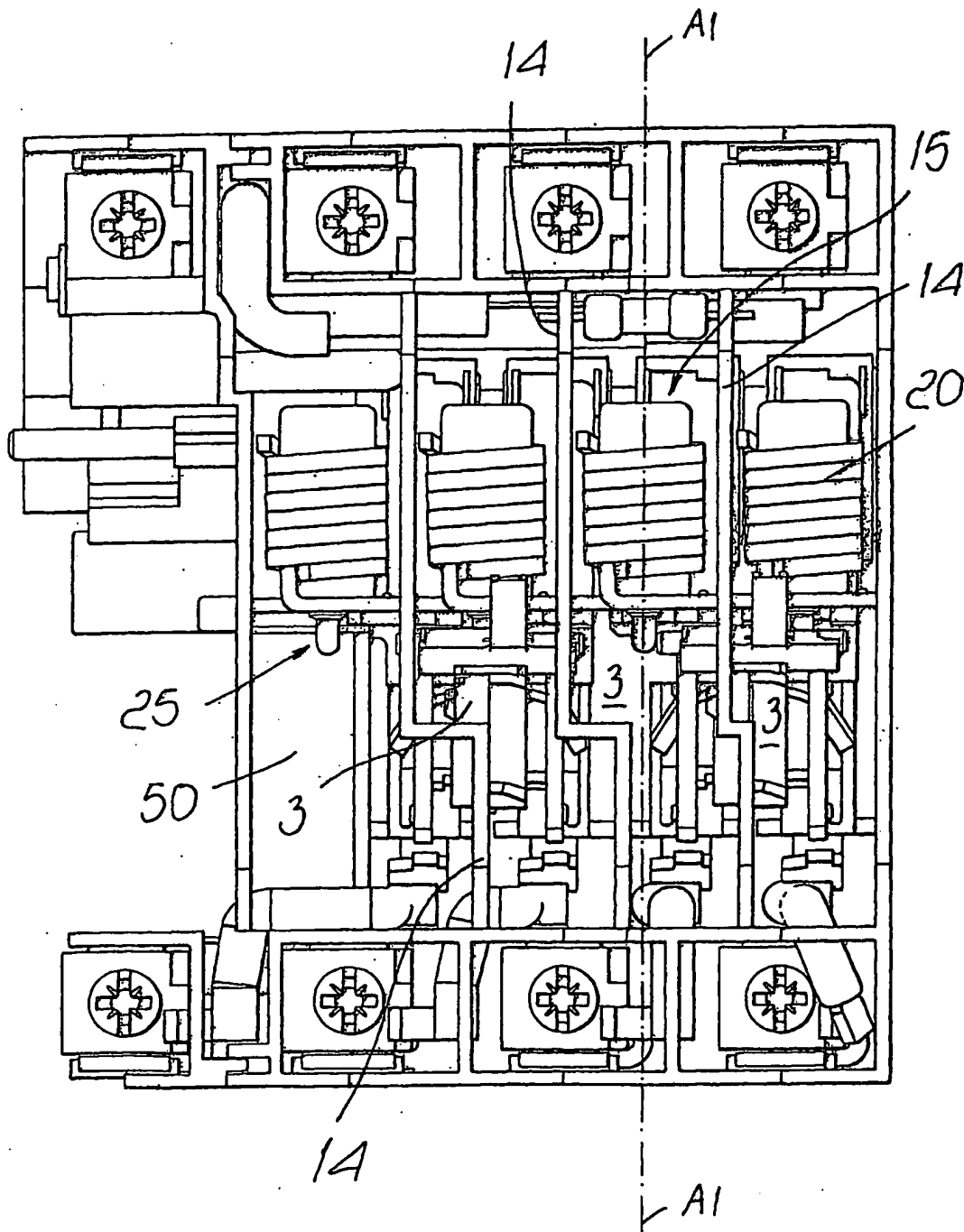


FIG. 4

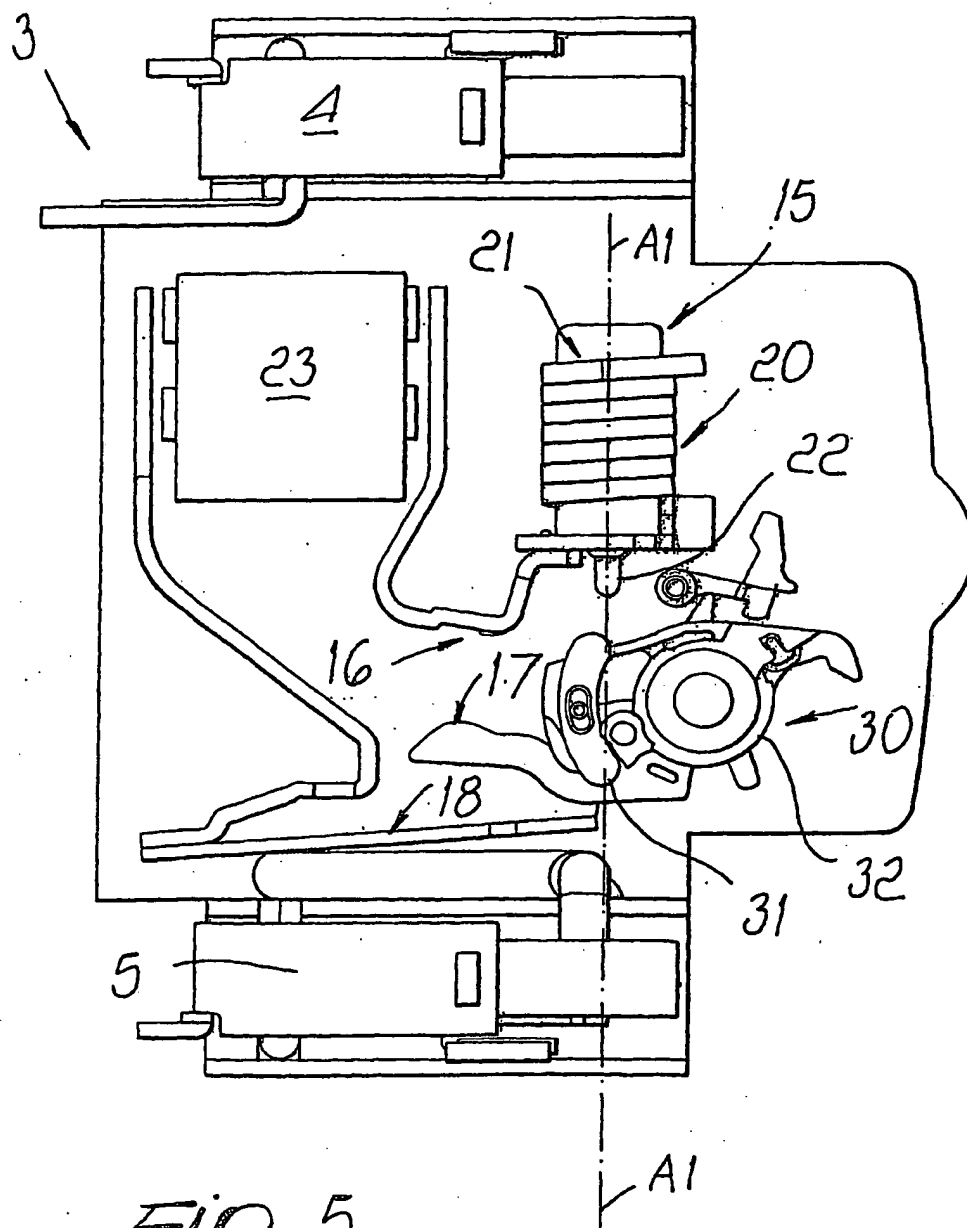


Fig. 5

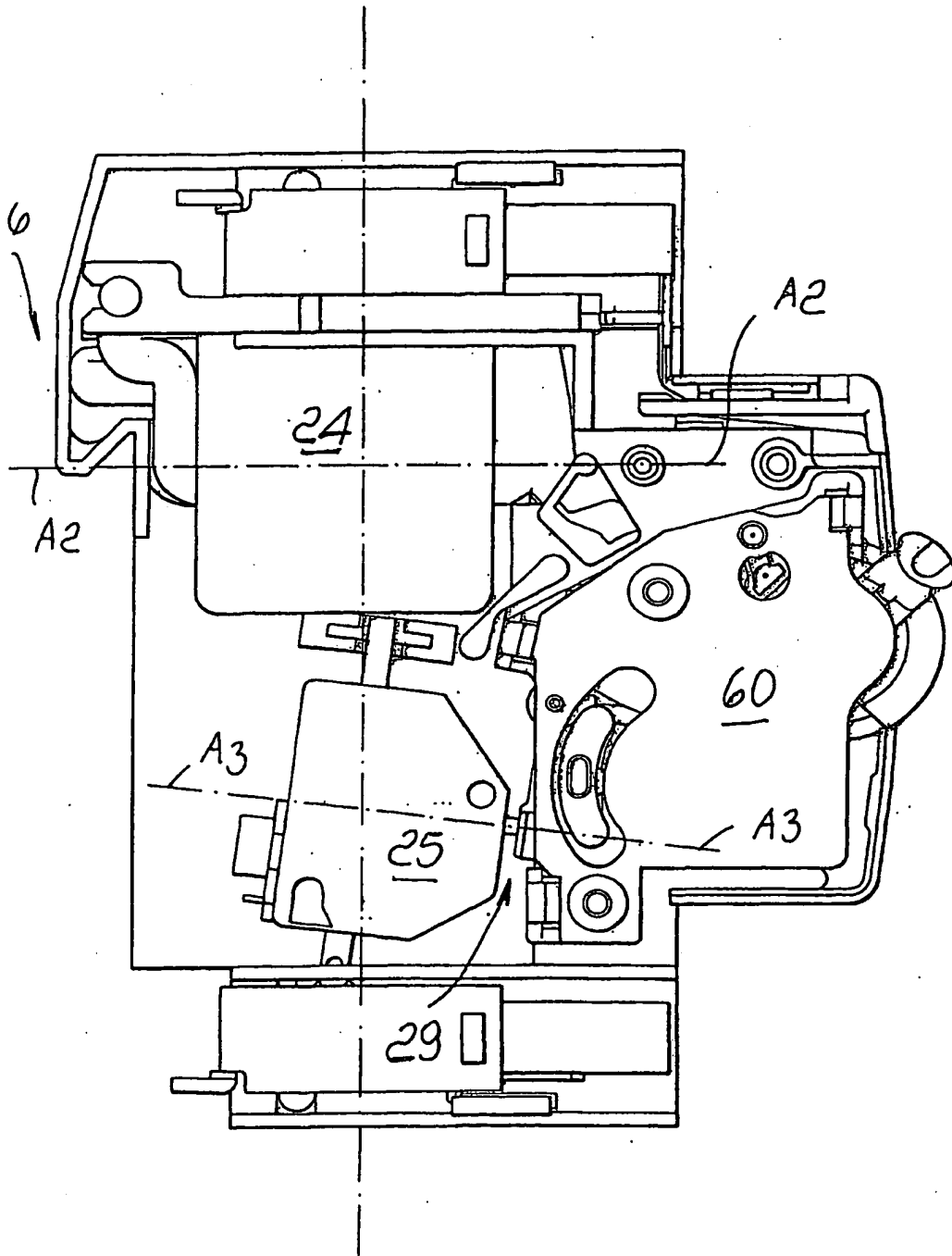
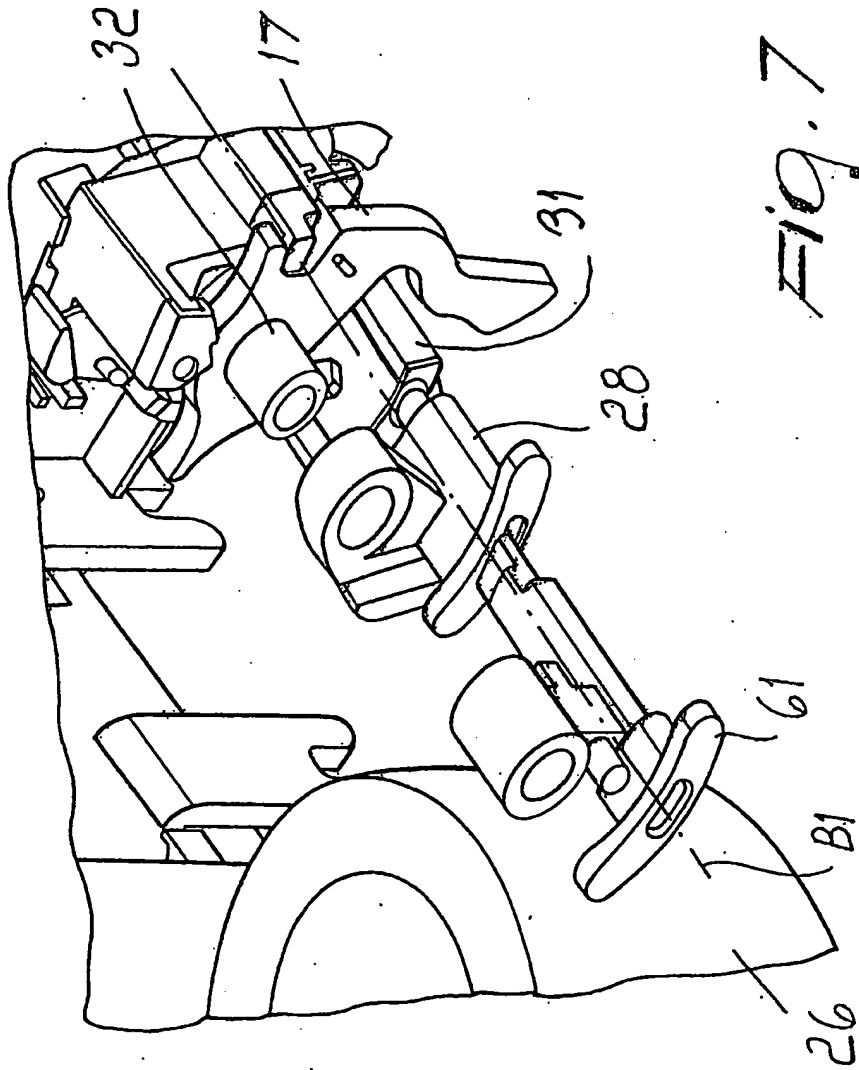


Fig. 6





# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/EP 02/08212

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 H01H83/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 1 371 007 A (SIEMENS AG) 28 August 1964 (1964-08-28) page 1, left-hand column, paragraph 2 -right-hand column, paragraph 1.	1
A	EP 0 948 021 A (LEGRAND SNC ;LEGRAND SA (FR)) 6 October 1999 (1999-10-06) abstract	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*S\* document member of the same patent family

Date of the actual completion of the international search

7 November 2002

Date of mailing of the international search report

14/11/2002

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
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Fax (+31-70) 340-3018

Authorized officer

L1bberecht, L

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 02/08212

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
FR 1371007	A	28-08-1964	DE	1169015 B	30-04-1964
EP 0948021	A	06-10-1999	FR	2777110 A1	08-10-1999
			EP	0948021 A1	06-10-1999
			HU	9900869 A2	28-12-1999
			PL	332348 A1	11-10-1999

DIALOG(R)File 351:Derwent WPI  
(c) 2006 The Thomson Corporation. All rts. reserv.

0013120009 - Drawing available

WPI ACC NO: 2003-201801/200319

XRPX Acc No: N2003-160739

**Modular four pole residual current circuit breaker for detection of earth leakage faults and which allows testing before all elements are installed**

Patent Assignee: ABB SERVICE SRL (ALLM)

Inventor: CARETONI A; COLOMBO G

**Patent Family (5 patents, 99 countries)**

Patent Application

Number Kind Date Number Kind Date Update

WO 2003012814 A1 20030213 WO 2002EP8212 A 20020723 200319 B

CN 1465086 A 20031231 CN 2002802554 A 20020723 200422 E

EP 1412960 A1 20040428 EP 2002767254 A 20020723 200429 E

WO 2002EP8212 A 20020723

AU 2002331289 A1 20030217 AU 2002331289 A 20020723 200452 E

IT 1325956 B 20041230 IT 2001MI1575 A 20010723 200561 E

Priority Applications (no., kind, date): IT 2001MI1575 A 20010723

#### **Patent Details**

Number Kind Lan Pg Dwg Filing Notes

WO 2003012814 A1 EN 24 7

National Designated States,Original: AE AG AL AM AT AU AZ BA BB BG BR BY  
BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID  
IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ  
NO NZ OM PH PL PT RO RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG US UZ  
VN YU ZA ZM ZW

Regional Designated States,Original: AT BE BG CH CY CZ DE DK EA EE ES FI  
FR GB GH GM GR IE IT KE LS LU MC MW MZ NL OA PT SD SE SK SL SZ TR TZ UG  
ZM ZW

EP 1412960 A1 EN PCT Application WO 2002EP8212

Based on OPI patent WO 2003012814

Regional Designated States,Original: AL AT BE BG CH CY CZ DE DK EE ES FI  
FR GB GR IE IT LI LT LU LV MC MK NL PT RO SE SI SK TR

AU 2002331289 A1 EN Based on OPI patent WO 2003012814

#### **Alerting Abstract WO A1**

**NOVELTY** - The residual current breaker comprises four magneto-thermal interruption units (3) that are assembled side by side and separated by partitions (14), and a residual current protection unit (6). By arranging the residual current part at one end of the enclosure the assembly can be divided into two steps, a first one being the assembly of the

magneto-thermal section which can then be tested before installing the residual current components

USE - To provide earth leakage circuit breaker that enables components to be tested during assembly

ADVANTAGE - Compact, reliable, easy to manufacture at competitive cost.

DESCRIPTION OF DRAWINGS - Diagram showing arrangement of circuit breaker internal compartments

3 Magneto- thermal units

6 Residual current units

14 Partitions

Title Terms /Index Terms/Additional Words: MODULE; FOUR; POLE; RESIDUE; CURRENT; CIRCUIT; BREAKER; DETECT; EARTH; LEAK; FAULT; ALLOW; TEST; ELEMENT; INSTALLATION

#### **Class Codes**

International Classification (Main): H01H, H01H-083/22

File Segment: EPI;

DWPI Class: X13

Manual Codes (EPI/S-X): X13-D05

#### **Original Publication Data by Authority**

##### **Australia**

Publication No. AU 2002331289 A1 (Update 200452 E)

Publication Date: 20030217

**\*\*MODULAR FOUR-POLE RESIDUAL CURRENT CIRCUIT BREAKER\*\***

Assignee: ABB SERVICE SRL (ALLM)

Inventor: CARETONI A

COLOMBO G

Language: EN

Application: AU 2002331289 A 20020723 (Local application)

Priority: IT 2001MI1575 A 20010723

Related Publication: WO 2003012814 A (Based on OPI patent )

##### **China**

Publication No. CN 1465086 A (Update 200422 E)

Publication Date: 20031231

Assignee: ABB SERVICE SRL; IT (ALLM)

Language: ZH

Application: CN 2002802554 A 20020723 (Local application)

Priority: IT 2001MI1575 A 20010723

**EPO**

Publication No. EP 1412960 A1 (Update 200429 E)

Publication Date: 20040428

**\*\*MODULARER VIERPOLIGER FEHLERSTROMSCHUTZSCHALTER  
MODULAR FOUR-POLE RESIDUAL CURRENT CIRCUIT BREAKER  
DISJONCTEUR DE COURANT RESIDUEL QUADRIPOLAIRE MODULAIRE\*\***

Assignee: ABB Service S.r.l., Via Arconati, 1, 20135 Milano, IT

Inventor: COLOMBO, Gabriele, Via Ugo Foscolo, 7/9, I-20011 Corbetta, IT

CARETTONI, Aldo, Via Caduti, 41, I-20020 Arese, IT

Agent: Giavarini, Francesco, ZANOLI GIAVARINI S.r.l., Viale Bianca Maria,  
35, 20122 Milano, IT

Language: EN

Application: EP 2002767254 A 20020723 (Local application)

WO 2002EP8212 A 20020723 (PCT Application)

Priority: IT 2001MI1575 A 20010723

Related Publication: WO 2003012814 A (Based on OPI patent )

Designated States: (Regional Original) AL AT BE BG CH CY CZ DE DK EE ES FI  
FR GB GR IE IT LI LT LU LV MC MK NL PT RO SE SI SK TR

Original IPC: H01H-83/22(A)

Current IPC: H01H-83/22(A)

Original Abstract: A modular four-pole residual current circuit breaker, comprising: --an enclosure, on which there are terminals for input and output connection to corresponding conductors of an electric circuit, with a front wall from which an actuation lever protrudes, a rear wall, two side walls that are substantially parallel to each other and whose distance is four times a base module M, a lower wall and an upper wall, the enclosure containing: --first, second, third and fourth magnetothermal interruption units, which are arranged mutually side by side and are separated by dividing walls, an input terminal and an output terminal being associated with the units; --a residual current protection unit, arranged at one of the lateral ends of the enclosure and laterally adjacent to the first magnetothermal interruption unit; its particularity consists of the fact that in a front view, the dividing wall between the first and second magnetothermal units is substantially step-shaped and forms a compartment for accommodating the first magnetothermal unit that has an upper part and a lower part that have mutually different widths, the lower part of the compartment being wider than the upper part and accommodating a transmission lever that is suitable to functionally couple the kinematic mechanism of the residual current unit with the kinematic mechanism of the magnetothermal units that are laterally adjacent to it.

**Italy**

Publication No. IT 1325956 B (Update 200561 E)

Publication Date: 20041230

Assignee: ABB SERVICE SRL (ALLM)

Inventor: COLOMBO G

CARETTONI A

Language: IT

Application: IT 2001MI1575 A 20010723 (Local application)

Original IPC: H01H-0/00(A)

Current IPC: H01H-0/00(A)

**WIPO**

Publication No. WO 2003012814 A1 (Update 200319 B)

Publication Date: 20030213

**\*\*MODULAR FOUR-POLE RESIDUAL CURRENT CIRCUIT BREAKER  
DISJONCTEUR DE COURANT RESIDUEL QUADRIPOLAIRE MODULAIRE\*\***

Assignee: ~(except US)~ ABB SERVICE S.r.L., Via Arconati, 1, I-20135

Milano, IT Residence: IT Nationality: IT (ALLM)

~(only US)~ COLOMBO, Gabriele, Via Ugo Foscolo, 7/9, I-20011 Corbetta, IT

Residence: IT Nationality: IT

~(only US)~ CARETTONI, Aldo, Via Caduti, 41, I-20020 Arese, IT Residence:

IT Nationality: IT

Inventor: COLOMBO, Gabriele, Via Ugo Foscolo, 7/9, I-20011 Corbetta, IT

Residence: IT Nationality: IT

CARETTONI, Aldo, Via Caduti, 41, I-20020 Arese, IT Residence: IT

Nationality: IT

Agent: GIAVARINI, Francesco, Giavarini E Associati S.r.l., Via XX

Settembre, 58/A, I-24122 Bergamo, IT

Language: EN (24 pages, 7 drawings)

Application: WO 2002EP8212 A 20020723 (Local application)

Priority: IT 2001MI1575 A 20010723

Designated States: (National Original) AE AG AL AM AT AU AZ BA BB BG BR BY  
BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID  
IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ  
NO NZ OM PH PL PT RO RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG US UZ  
VN YU ZA ZM ZW

(Regional Original) AT BE BG CH CY CZ DE DK EA EE ES FI FR GB GH GM GR IE

IT KE LS LU MC MW MZ NL OA PT SD SE SK SL SZ TR TZ UG ZM ZW

Original IPC: H01H-83/22(A)

Current IPC: H01H-83/22(A)

Original Abstract: A modular four-pole residual current circuit breaker, comprising: --an enclosure, on which there are terminals for input and output connection to corresponding conductors of an electric circuit, with a front wall from which an actuation lever protrudes, a rear wall, two side walls that are substantially parallel to each other and whose distance is four times a base module M, a lower wall and an upper wall, the enclosure containing: --first, second, third and fourth magnetothermal interruption units, which are arranged mutually side by side and are separated by dividing walls, an input terminal and an output terminal being associated with the units; --a residual current protection unit, arranged at one of the lateral ends of the enclosure and laterally adjacent to the first magnetothermal interruption unit; its particularity consists of the fact that in a front view, the dividing wall between the first and second magnetothermal units is substantially step-shaped and forms a compartment for accommodating the first magnetothermal unit that has an upper part and a lower part that have mutually different widths, the lower part of the compartment being wider than the upper part and accommodating a transmission lever that is suitable to functionally couple the kinematic mechanism of the residual current unit with the kinematic mechanism of the magnetothermal units that are laterally adjacent to it.

La presente invention concerne un disjoncteur de courant modulaire quadripolaire modulaire comportant: une enceinte, sur laquelle se trouvent des bornes pour une connexion en entree et en sortie a des conducteurs correspondants d'un circuit electrique, avec une paroi avant a partir de laquelle se trouve en saillie un levier d'actionnement, une paroi arriere, deux parois laterales qui sont sensiblement paralleles l'une a l'autre et dont la distance est de quatre fois celle d'un module de base M, une paroi inferieure et une paroi superieure, l'enceinte comprenant: des premiere, deuxieme, troisieme et quatrieme unites de coupures magnetothermiques, qui sont disposees adjacentes les une des autres et separees par des parois de separation, une borne d'entree et une borne de sortie etant associees aux unites; une unite de protection de courant residuel, dispose au niveau de l'une des extremités laterales de l'enceinte et lateralement adjacente a la premiere unite de coupure magnetothermique. Le disjoncteur de l'invention est caracterise en ce que vue de face, la paroi de separation entre les premiere et deuxieme unites magnetothermique est sensiblement etagee et constitue un compartiment pour loger la premiere unite magnetothermique qui presente une partie superieure et une partie inferieure de differentes largeurs, la partie inferieure du compartiment etant plus large que la partie superieure et logeant un levier de transmission qui est apte a coupler en fonctionnement le mecanisme cinematique du courant residuel avec le mecanisme cinematique des unites magnetothermiques qui lui sont lateralement adjacentes.

# 中华人民共和国国家知识产权局

邮政编码: 100037

北京市阜成门外大街2号万通新世界广场8层  
中国国际贸易促进委员会专利商标事务所  
王永刚

发文日期

申请号: 2003101244240



申请人: 佳能株式会社

发明创造名称: 电子发射设备, 电子发射装置, 图像显示装置和光发射装置



## 第一次审查意见通知书

- ☒ 应申请人提出的实审请求, 根据专利法第 35 条第 1 款的规定, 国家知识产权局对上述发明专利申请进行实质审查。

☐ 根据专利法第 35 条第 2 款的规定, 国家知识产权局决定自行对上述发明专利申请进行实质审查。
- ☒ 申请人要求以在:

JP 专利局的申请日 2000 年 09 月 01 日为优先权日,  
JP 专利局的申请日 2001 年 08 月 24 日为优先权日。

☐ 申请人已经提交了经原申请国受理机关证明的第一次提出的在先申请文件的副本。

☐ 申请人尚未提交经原申请国受理机关证明的第一次提出的在先申请文件的副本, 根据专利法第 30 条的规定视为未提出优先权要求。
- ☒ 经审查, 申请人于:

年 月 日提交的 不符合实施细则第 51 条的规定;  
年 月 日提交的 不符合专利法第 33 条的规定;

2005 年 3 月 3 日提交的权利要求 15、30、32-33、35 不符合专利法第 43 条的规定。
- 审查针对的申请文件:

☐ 原始申请文件。 ☒ 审查是针对下述申请文件的

分案提交日提交的申请文件的权利要求第 项、说明书第 1-24 页、附图第 1-13 页;  
2005 年 3 月 3 日提交的权利要求第 1-37 项、说明书第 页、附图第 页;  
年 月 日提交的权利要求第 项、说明书第 页、附图第 页;  
年 月 日提交的权利要求第 项、说明书第 页、附图第 页;

分案提交日提交的申请文件的说明书摘要和摘要附图。
- ☐ 本通知书是在未进行检索的情况下作出的。

☒ 本通知书是在进行了检索的情况下作出的。

☒ 本通知书引用下述对比文献(其编号在今后的审查过程中继续沿用):

编号	文件号或名称	公开日期(或抵触申请的申请日)
1	CN1465086A	2003-12-31(抵触申请的申请日 2001-5-22, 优先权日 2000-5-26)
- 审查的结论性意见:

☐ 关于说明书:

☐ 申请的内容属于专利法第 5 条规定的不授予专利权的范围。

☐ 说明书不符合专利法第 26 条第 3 款的规定。

☐ 说明书不符合专利法第 33 条的规定。

☐ 说明书的撰写不符合实施细则第 18 条的规定。

21301  
2002.8



回函请寄: 100088 北京市海淀区翻门桥西土城路 8 号 国家知识产权局专利局受理处收  
(注: 凡寄给审查员个人的信函不具有法律效力)



- ☐
- ☒关于权利要求书:
- ☒权利要求1-4、10-11、14、36-37不具备专利法第22条第2款规定的新颖性。
- ☐权利要求\_\_\_\_\_不具备专利法第22条第3款规定的创造性。
- ☐权利要求\_\_\_\_\_不具备专利法第22条第4款规定的实用性。
- ☐权利要求\_\_\_\_\_属于专利法第25条规定的不授予专利权的范围。
- ☐权利要求\_\_\_\_\_不符合专利法第26条第4款的规定。
- ☒权利要求(1-4、10-11、14-15、30、32-33、35-37)与(5-9、12-13)与(16-19)与(20-29)与(31、34)之间不符合专利法第31条第1款的规定。
- ☐权利要求\_\_\_\_\_不符合专利法第33条的规定。
- ☐权利要求\_\_\_\_\_不符合专利法实施细则第2条第1款关于发明的定义。
- ☐权利要求\_\_\_\_\_不符合专利法实施细则第13条第1款的规定。
- ☐权利要求\_\_\_\_\_不符合专利法实施细则第20条的规定。
- ☐权利要求\_\_\_\_\_不符合专利法实施细则第21条的规定。
- ☐权利要求\_\_\_\_\_不符合专利法实施细则第22条的规定。
- ☐权利要求\_\_\_\_\_不符合专利法实施细则第23条的规定。
- ☒权利要求15、30、32-33、35不符合专利法实施细则第43条的规定。

上述结论性意见的具体分析见本通知书的正文部分。

7. 基于上述结论性意见, 审查员认为:

- ☐申请人应按照通知书正文部分提出的要求, 对申请文件进行修改。
- ☒申请人应在意见陈述书中论述其专利申请可以被授予专利权的理由, 并对通知书正文部分中指出的不符合规定之处进行修改, 否则将不能授予专利权。
- ☐专利申请中没有可以被授予专利权的实质性内容, 如果申请人没有陈述理由或者陈述理由不充分, 其申请将被驳回。

☐

8. 申请人应注意下述事项:

- (1) 根据专利法第37条的规定, 申请人应在收到本通知书之日起的肆个月内陈述意见, 如果申请人无正当理由逾期不答复, 其申请将被视为撤回。
- (2) 申请人对其申请的修改应符合专利法第33条的规定, 修改文本应一式两份, 其格式应符合审查指南的有关规定。
- (3) 申请人的意见陈述书和/或修改文本应邮寄或递交国家知识产权局专利局受理处, 凡未邮寄或递交给受理处的文件不具备法律效力。
- (4) 未经预约, 申请人和/或代理人不得前来国家知识产权局专利局与审查员举行会晤。

9. 本通知书正文部分共有 4 页, 并附有下列附件:

- ☒引用的对比文件的复印件共 1 份 7 页。 ☐



审查员: 向莉(5293)

2006年6月12日

审查部门 审查协作中心



## 第一次审查意见通知书正文

申请号：2003101244240

本申请涉及一种电子发射设备，电子发射装置，图像显示装置和光发射装置，经审查，现提出如下的审查意见。

1. 本申请有37个权利要求，分成五组：（1）权利要求1-4、10-11、14-15、30、32-33、35-37：其基于一个总的发明构思“石墨不与碳纤维的轴向平行”；（2）权利要求5-9、12-13：其基于一个总的发明构思“碳纤维的每个包括石墨”；（3）权利要求16-19：其基于一个总的发明构思“第一电极和第二电极由绝缘体的表面彼此电绝缘”；（4）权利要求20-29：其基于一个总的发明构思“第一和第二电极不与配置在第二电极上的一个绝缘层相绝缘”；（5）权利要求31、34：其基于一个总的发明构思“石墨不与碳纤维的轴向垂直”。由此可知，这5组权利要求之间不属于一个总的发明构思，不符合专利法第三十一条第一款的规定。申请人应当删除不符合单一性规定的权利要求。针对本申请中不再要求保护的发明，申请人可以在本专利申请结案之前另行提交分案申请。下面具体针对第1组权利要求进行审查。

2. 本申请是申请号为01142775.2的专利申请的分案申请，其内容超出了原申请公开的范围，不符合专利法实施细则第四十三条第一款的规定。在本分案申请中，申请人增加了如下的内容：“一种三极管型电子发射装置”（见权利要求15）和“控制电极，用于控制来自配置在第一基底上的（阴极上的）多个碳纤维中至少一个中的发射电流的量”（见权利要求30、32-33、35），这部分内容既没有明确记载在原申请文件中，也不能由原申请文件公开的内容直接地、毫无疑义地确定，因此本分案申请超出了原申请公开的范围。申请人应当修改本分案申请的申请文件，将本申请的内容限制在原申请公开的范围内，否则审查员将依据专利法实施细则第五十三条第（四）项的规定驳回本分案申请。

3. 权利要求1请求保护一种电子发射器件。对比文件1是一件由他人向中国专利局提出的专利申请，其优先权日2000-5-26（经核实，可以享受该优先权日）早于本申请的最早优先权日2000-9-1，公开日为2003-12-31，在本申请的申请日之后。对比文件1公开了一种电子发射器件，其中（说明书第3页第2行至第5页第12行）具体公开了

以下技术特征：一种电子发射器件，包括以一定间隔布置在第一基底的表面上的阴极和栅极；以及多个碳纤维，布置在阴极上并且电连接到阴极，其中碳纤维的每个具有多个石墨烯片晶，石墨烯片晶相对于纤维轴以一个角度排列，所述角度可以是锐角或90度，相当于多个石墨被分层以便不与所述纤维的轴向平行。由此可见，对比文件1已经公开了权利要求1的全部技术特征，且对比文件1所公开的技术方案与权利要求1所要求保护的技术方案属于同一技术领域，并能产生相同的技术效果，因此该对比文件构成了本申请权利要求1的“抵触申请”，从而使该权利要求所要求保护的技术方案不具备专利法第二十二条第二款规定的新颖性。

4. 权利要求2的附加技术特征是“其中多个石墨基本上彼此平行”，对比文件1公开了“石墨烯片晶相对于纤维轴以一个角度排列”（参见说明书第3页第12行），石墨片以一个角度排列显然是彼此平行的，因此当其引用的权利要求1不具备新颖性时，该从属权利要求也不具备专利法第二十二条第二款规定的新颖性。

5. 权利要求3请求保护一种光发射装置，对比文件1公开了一种光发射装置，具体公开了一种电子场致发射体和场致发射体阴极可用于平板电脑、电视和其它种显示器、真空电子设备、发射闸门放大器、速调管以及照明设备中，则光发射装置必然包括电子发射器件和光发射部件（参见说明书第2页第29行至第31行），并且权利要求1-2相对于对比文件1不具备新颖性，因此该权利要求也不具备专利法第二十二条第二款规定的新颖性。

6. 权利要求4请求保护一种图像显示装置，对比文件1公开了一种图像显示装置，具体公开了一种电子场致发射体和场致发射体阴极可用于平板电脑、电视和其它种显示器、真空电子设备、发射闸门放大器、速调管以及照明设备中，则图像显示装置必然包括多个电子发射器件和光发射部件，当用从多个电子发射器件中一些发出的电子照射时，光发射部件能够发射光（参见说明书第2页第29行至第31行），并且权利要求1-2相对于对比文件1不具备新颖性，因此该权利要求也不具备专利法第二十二条第二款规定的新颖性。

7. 权利要求10对权利要求3做了进一步的限定，对比文件1公开了以下技术特征：一种电子场致发射体和场致发射体阴极可用于平板电脑、电视和其它种显示器、真空电子设备、发射闸门放大器、速调管以及照明设备中，则光发射部件必然包括荧光体和阳极，并且布置在与第一基底分开布置的第二基底上（参见说明书第2页第29行至第31行），因此当其引用的权利要求3不具备新颖性时，该从属权利要求也不具备专利法第二十二条第二款规定的新颖性。

8. 权利要求11对权利要求4做了进一步的限定, 对比文件1公开了以下技术特征: 一种电子场致发射体和场致发射体阴极可用于平板电脑、电视和其它种显示器、真空电子设备、发射闸门放大器、速调管以及照明设备中, 则光发射部件必然包括荧光体和阳极, 并且布置在与第一基底分开布置的第二基底上(参见说明书第2页第29行至第31行), 因此当其引用的权利要求4不具备新颖性时, 该从属权利要求也不具备专利法第二十二条第二款规定的新颖性。

9. 权利要求14请求保护一种图像显示装置。对比文件1是一件由他人向中国专利局提出的专利申请, 其优先权日2000-5-26(经核实, 可以享受该优先权日)早于本申请的最早优先权日2000-9-1, 公开日为2003-12-31, 在本申请的申请日之后。对比文件1公开了一种图像显示装置, 其中(说明书第2页第29行至第5页第12行)具体公开了以下技术特征: 一种图像显示装置, 包括布置在第一基底上、并且包括阴极和栅极的电子发射器件; 其中电子发射器件包括电连接到并且配置在阴极上的多个碳纤维, 其中碳纤维的每个具有多个石墨烯片晶, 石墨烯片晶相对于纤维轴以一个角度排列, 所述角度可以是锐角或90度, 相当于多个石墨被分层以便不与每个纤维的轴向平行, 其必然具有布置在第二基底上的荧光体和阳极。由此可见, 对比文件1已经公开了权利要求14的全部技术特征, 且对比文件1所公开的技术方案与权利要求14所要求保护的技术方案属于同一技术领域, 并能产生相同的技术效果, 因此该对比文件构成了本申请权利要求14的“抵触申请”, 从而使该权利要求所要求保护的技术方案不具备专利法第二十二条第二款规定的新颖性。

10. 权利要求36请求保护一种电视装置, 对比文件1公开了一种电视, (参见说明书第2页第29行), 包括图像显示装置, 并且权利要求14相对于对比文件1不具备新颖性, 因此该权利要求也不具备专利法第二十二条第二款规定的新颖性。

11. 权利要求37请求保护一种计算机装置, 对比文件1公开了一种电脑, (参见说明书第2页第29行), 包括图像显示装置, 并且权利要求14相对于对比文件1不具备新颖性, 因此该权利要求也不具备专利法第二十二条第二款规定的新颖性。

12. 每一项权利要求只允许在其结尾处使用句号(参见审查指南第二部分第二章第3.3节)。而权利要求1中出现了2个句号, 不符合上述规定, 审查人应将前1个句号, 改为“逗号”或“分号”。

基于上述理由，本申请按目前的文本是不能授权的，申请人应根据上述审查意见在指定的期限内提交新的权利要求书和说明书，修改时应满足专利法第三十三条的规定，不得超出原说明书和权利要求书的记载范围，若仍存在上述属于专利法实施细则第五十三条所记载的情况，根据专利法第三十八条的规定，本申请将被驳回。

审查员：向莉

[19] 中华人民共和国国家知识产权局

[51] Int. Cl<sup>7</sup>

H01J 1/304



# [12] 发明专利申请公开说明书

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权利要求书 1 页 说明书 5 页

[54] 发明名称 催化生成的碳纤维场致发射体和由此制得的场致发射体阴极

[57] 摘要

本发明提供一种包括在金属小颗粒上由含碳气体催化分解所生成的碳纤维的电子场致发射体和场致发射体阴极。每根碳纤维都有石墨烯片晶(graphene platelets), 石墨烯片晶相对于纤维轴以一个角度排列以便碳纤维的周边基本上由石墨烯片晶的边缘组成。这些场致发射体和场致发射体阴极可用于电脑、电视和其它种平板显示器中。

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1. 一种电子场致发射体，其包括在金属小颗粒上由含碳气体催化分解所生成的碳纤维，每根碳纤维都有石墨烯片晶，石墨烯片晶相对于纤维轴以一个角度排列以便碳纤维的周边基本上由石墨烯片晶的边缘组成。  
5
2. 根据权利要求1的电子场致发射体，其中所述的角度是锐角。
3. 根据权利要求1的电子场致发射体，其中所述的角度为 $90^\circ$ 。
4. 一种电子场致发射体阴极，包括连接在基底上的催化生成的碳纤维。

催化生成的碳纤维场致发射体和  
由此制得的场致发射体阴极

5 发明领域

本发明涉及在金属小颗粒上由含碳气体催化分解生成(grown)的碳纤维作为电子场致发射体的应用,特别是它们在显示屏中的场致发射体阴极中的应用。

10 发明背景

场致发射电子源通常称作场致发射材料或场致发射体,可用于各种电子学应用中,例如真空电子设备、平板电脑和电视显示器、发射闸门放大器和速调管,以及用于照明中。

在许多种应用中使用显示屏,例如家用和商用电视、膝上型和桌上型电脑、室内和室外广告以及信息展示。与大多数电视和桌上型电脑的厚的阴极射线管显示器(monitors)相比,平板显示器(flat panel display)仅几英寸厚。平板显示器对于膝上型电脑是必需的,而且对于许多其它应用在重量和尺寸上也具有优点。目前膝上型电脑平板显示器使用液晶,通过施加弱的电信号液晶可从透明状态转换到不透明状态。难以可靠地生产出在尺寸上比适于膝上型电脑更大的这种显示器来。

已有建议用等离子显示器作为液晶显示器的替代物。等离子显示器采用微小的带电气体的象素单元(pixel cell)来产生图象,并要求比较大的电功率来工作。

25 已有提议采用具有阴极的平板显示器,这种阴极使用场致发射电子源,即场致发射材料或场致发射体,还有在由场致发射体发射的电子轰击下能发光的无机发光材料。这种显示器可提供常规阴极射线管视觉显示的优点,以及其它平板显示器的厚度、重量和功率消耗的优点。美国专利4,857,799和5,015,912公开了采用钨、钼或硅构成的微端(micro-tip)阴极的矩阵选址平板显示器(matrix-addressed flat panel display)。WO 94-15352、WO 94-15350和WO 94-28571公开了其中阴极具有比较平的发射表面的平板显示器。



已在两种纳米管 (nanotube) 碳结构中观测到场致发射。在 Chem. Phys. Letters 233, 63 (1955) 和 Mat. Res. Soc. Symp. Proc. Vol. 359, 99 (1995) 中, L. A. Chernozatonskii 等已在  $10^{-5} \sim 10^{-6}$  托真空中通过石墨的电子发射在各种基底上制备纳米管碳结构的膜。这些膜由处于彼此邻接、排成直线的管状碳分子组成。形成两种管状分子: A-管状物 (A-tubelites), 其结构包括形成直径为 10~30nm 丝束的单层石墨状细管; B-管状物 (B-tubelites), 其包括具有圆锥形或穹顶状端部的直径为 10~30nm 大多数为多层的石墨状管。他们报道了来自这些结构表面的相当大的场致电子发射, 并认为是由于在纳米尺寸端部场的高度密集 (concentration) 产生的。在 Mat. Res. Soc. Symp. Proc. Vol. 359, 93 (1995) 中, B. H. Fishbine 等论述了关于 “buckytube” (即碳纳米管) 冷场致发射体阵列阴极发展的试验和理论。

N. M. Rodriguez 等在 J. Catal. 144, 93 (1993) 中, N. M. Rodriguez 在 J. Mater. Res. 8, 3233 (1993) 中, 论述了在金属小颗粒上某些烃催化分解所生成的碳纤维的生长和性能。专利 U. S. 5, 149, 584、U. S. 5, 413, 866、U. S. 5, 458, 784、U. S. 5, 618, 875 和 U. S. 5, 653, 951 进一步公开了这种纤维的应用。

仍旧需要一种用于平板显示器中的、易于得到的电子场致发射体。

### 发明概述

本发明提供了一种包括在金属小颗粒上由含碳气体催化分解生成的碳纤维的电子场致发射体。每根碳纤维都有石墨烯片晶 (graphene platelets), 石墨烯片晶相对于纤维轴以一个角度排列以便碳纤维的周边基本上由石墨烯片晶的边组成。

本发明也提供一种包括连在基底表面的催化生成的碳纤维的场致发射体阴极, 其中催化生成 (catalytically grown) 的碳纤维即在金属小颗粒上由含碳气体催化分解所生成的碳纤维。

这些场致发射体和场致发射体阴极可用于平板电脑、电视和其它种显示器, 真空电子设备, 发射闸门放大器, 速调管以及照明设备中。平板显示器可以是平面的或曲面的。

## 发明详述

本发明提供一种新型的电子场致发射体、在金属小颗粒上由含碳气体催化分解所生成的碳纤维，以及包括这种催化生成的碳纤维的电子场致发射体阴极。这种碳纤维可按照 N.M. Rodriguez 等在 J. Catal. 144, 93 (1993) 中、N.M. Rodriguez 在 J. Mater. Res. 8, 3233 (1993) 中所描述的来制备。简而言之，在 600℃ 下，在 10% 氢气-氩气流中，粉末金属催化剂被还原，然后使之处于所需要的反应温度中。预先确定的氢气、烃和惰性气体的混合物引入到该体系中，而后反应开始进行。例如在 600℃ CO-H<sub>2</sub> (4:1) 混合物在铁上面进行反应。

- 10 当在这里使用时，“催化生成的碳纤维”意思是在金属小颗粒上由含碳气体催化分解所生成的碳纤维，每根这种碳纤维都有石墨片晶，石墨片晶相对于纤维轴以一个角度排列以便碳纤维的周边基本上由石墨片晶的边缘组成。所述角度可以是锐角或 90°。

- 15 催化生成的碳纤维是良好的电子场致发射体，当连接到基底上时，其作为电子场致发射体阴极是非常有用的。

- 各种方法可用来将催化生成的碳纤维连接到基底上。在生产放置场致发射体阴极的设备的条件下，以及在其使用条件下，如典型的是真空条件和最高到约 450℃ 的温度，这种连接装置必须承受得住并且保持其完整性。因此，有机材料一般不适用于将颗粒连接到基底上，许多无机材料与碳的不良粘合进一步限制了可使用材料的选择。

- 20 优选的方法是：将包括催化生成的碳纤维和玻璃粉、金属粉末或金属涂料或其混合物的浆料，以所希望的图案筛网印刷到基底上，然后烧制这个干的制成图案的浆料。对于更广泛的应用，例如那些要求更好的清晰度，优选的方法包括：将进一步包含光引发剂和可光硬化单体的浆料进行筛网印刷，再将干浆料进行光制图案 (photopatterning)，然后烧制该制成图案的浆料。

- 25 基底可以是浆料组合物能粘着的任何材料。如果浆料是非导电的，以及使用非导电基底，则需要电导体膜用作阴极电极及向催化生成的碳纤维施加电压以及供应电子的构件。硅、玻璃、金属或耐火材料（例如氧化铝）可用作基底。对于显示器应用，优选的基底是玻璃，特别优选钠钙玻璃。为了在玻璃上的最佳导电率，银浆料可在空气或氮气中、在 500~550℃ 预先烧制在玻璃上。这样形成的导电层然后可用发

射体浆料在其上面覆盖印刷。

用于筛网印刷的发射体浆料通常含有催化生成的碳纤维、有机介质、溶剂、表面活性剂，以及低软化点玻璃粉、金属粉末或金属涂料或其混合物。介质和溶剂的作用是，在具有可用于常规制作图案工艺（如筛网印刷）的合适流变能力的浆料中，悬浮和分散颗粒组分（即固体）。在本领域中许多已知的这样的介质。可应用的树脂的例子是纤维素树脂，如乙基纤维素，以及各种分子量的醇酸树脂。有用溶剂的例子是丁基卡必醇、乙酸丁基卡必醇酯、二丁基卡必醇、邻苯二甲酸二丁酯和茛品醇。配入这些和其它溶剂，以达到所希望的粘度和挥发性要求。表面活性剂可用来改善颗粒的分散。有机酸（如油酸和硬脂酸）和有机磷酸酯（如卵磷脂或 Gafac® 磷酸酯）是常用表面活性剂。

要求玻璃粉在烧制温度下足够软化，以便与基底和催化生成的碳纤维粘合。可采用铅玻璃粉和其它低软化点的玻璃，如硼硅酸钙或硼硅酸锌。如果需要具有较高导电率的可筛网印刷的组合物，则浆料也含有金属，例如银或金。以浆料总重量计，浆料通常含有约 40 wt% ~ 约 60 wt% 的固体。这些固体包括催化生成的碳纤维和玻璃粉和/或金属组分。组合的变化可用来调节粘度和印刷材料的最终厚度。

发射体浆料通常采用研磨催化生成的碳纤维、有机介质、表面活性剂、溶剂以及或者低软化点玻璃粉、金属粉末或金属涂料或其混合物的混合物来制得。该浆料混合物可采用众所周知的筛网印刷技术，例如通过采用 165 ~ 400 筛目不锈钢筛网来筛网印刷。浆料可以连续膜或以所希望图案的形式沉积。当基底是玻璃时，那么浆料在氮气中、在约 350℃ ~ 约 500℃、优选在约 450℃ 的温度下烧制约 10 分钟。如果气氛中不含有氧气，对于可承受更高温度的基底，则可采用更高的烧制温度。然而，浆料中的有机组分在 350℃ ~ 450℃ 下被有效地挥发了，留下由催化生成的碳纤维和玻璃和/或金属导体组成的组合物层。在氮气中的烧制过程中，催化生成的碳纤维经历了觉察不到的氧化或其它化学或物理变化。

如果筛网印刷的浆料要光制图案 (photopatterned)，则该浆料含有光引发剂和光可硬化单体，光可硬化单体例如包括至少一种含有至少一种可聚合烯基 (ethylenic group) 的可加成聚合的烯性

(ethylenically) 不饱和化合物。

采用包括两个电极的平板发射测量装置, 其中一个电极用作阳极或集电极, 另一个用作阴极, 对所得到的试样进行场致发射试验。阴极由安装在聚四氟乙烯 (PTFE) 支座 (holder) 中的铜块组成。铜块收纳在 1 英寸 x 1 英寸 (2.5cm x 2.5cm) 面积的 PTFE 中, 将试样基底安装铜块上, 通过铜带在铜块和试样基底之间形成电接触。高压引线连接在铜块上。阳极以一个可变距离与试样保持平行, 但是一旦这个距离选定了, 对于一套给定的试样的测量, 它保持固定。除非另有说明, 采用 1.25mm 的间距。阳极由涂有通过化学气相淀积而淀积的氧化铟锡的玻璃板组成。然后用标准的基于 ZnS 的白无机发光材料、Phosphor p-31、从 Electronic Space Products International 得到的 Type 139 涂敷。将一个电极连接到氧化铟锡涂层上。

将试验装置插入真空系统中, 该系统抽真空至低于  $1 \times 10^{-6}$  托 ( $1.3 \times 10^{-4}$  Pa) 的基础压力。将一负电压施加到阴极上, 测量发射电流, 作为所施加电压的函数。

#### 本发明实施例

催化生成的碳纤维以粉末的形式从 Catalytic Materials Ltd, 12 Old Stable Drive, Mansfield, MA. 得到。将 0.1513 克这种催化生成的碳纤维加入到 0.1502 克玻璃 (Bayer PK 8701, CAS 登记号 65997-18-4) 和 1.5012 克常用有机介质中, 其中有机介质主要包括萘品醇中的乙基纤维素。这些组分在玻璃板研磨机上混合达 75 转, 以形成发射体浆料。预烧制的含银玻璃基底采用下面方法制备: 将在常用有机乙基纤维素类介质中的银粉和低熔融玻璃粉的混合物进行筛网印刷, 接着在 525℃ 下进行烧制。然后采用 325 筛目的筛网, 1cm<sup>2</sup> 正方形的发射体浆料的图案被筛网印刷到预烧制的含银玻璃基底上, 随后该试样在 120℃ 下干燥 10 分钟。然后干的试样在氮气中、在 450℃ 下烧制 10 分钟。烧制之后, 浆料在基底上形成一个粘着的涂层。烧制的样品按照说明书中所述的方法进行场致发射试验。在施加 4500V 的电压下, 发射电流大于  $10^{-7}$  amp。

# 申请校对表

委托人: JP000120 OKABE INTERNATIONAL PATENT OFFICE  
 申请人: JP000808 CANON KABUSHIKI KAISHA (キヤノン株式会社)

## 翻译错误原因

- 校对时间: 校对代理人: 本案代理人: 蔡展
- A. 在语法和结构上错误的英文和日文句子  
 B. 模糊的原文 (一词多义, Canon 专有技术名词)  
 C. 打印成其它简单的原文错误  
 D. 翻译者对技术没有理解充分  
 E. 翻译者对原文的理解不恰当  
 F. 翻译者的中文表达不恰当  
 G. 翻译者遗漏了必要的单词、词语、或句子  
 H. 翻译者打印错误  
 I. 其他原因

No.	对方卷号: CPO15727CNA	我方卷号: IIE033448	A	B	C	D	E	F	G	H	I	处理结果及解释 (如果有的话)
1	原文:											<input type="checkbox"/> 已向日本事务所报告, 并收到指示, 已按照指示进行了修改
	中文错误译文:											<input type="checkbox"/> 已向日本事务所报告, 没收到指示, 在约限日前我方主动修改
	中文错误译文的英文或日文译文:											<input type="checkbox"/> 其他: <input type="checkbox"/> 解释:
2	原文:											<input type="checkbox"/> 已向日本事务所报告, 并收到指示, 已按照指示进行了修改
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3	原文:											<input type="checkbox"/> 已向日本事务所报告, 并收到指示, 已按照指示进行了修改
	中文错误译文:											<input type="checkbox"/> 已向日本事务所报告, 没收到指示, 在约限日前我方主动修改
	中文错误译文的英文或日文译文:											<input type="checkbox"/> 其他: <input type="checkbox"/> 解释:
4	原文:											<input type="checkbox"/> 已向日本事务所报告, 并收到指示, 已按照指示进行了修改
	中文错误译文:											<input type="checkbox"/> 已向日本事务所报告, 没收到指示, 在约限日前我方主动修改
	中文错误译文的英文或日文译文:											<input type="checkbox"/> 其他: <input type="checkbox"/> 解释:
5	原文:											<input type="checkbox"/> 已向日本事务所报告, 并收到指示, 已按照指示进行了修改
	中文错误译文:											<input type="checkbox"/> 已向日本事务所报告, 没收到指示, 在约限日前我方主动修改
	中文错误译文的英文或日文译文:											<input type="checkbox"/> 其他: <input type="checkbox"/> 解释:

Note: 请在答复OA后和收到授通后一个月内把此表交给本处处长 (日文最好用outlook转给处长)

07/03/2006